THE MGA BULLETIN

JANUARY 1948

No. 10

ORGAN OF THE MUSHROOM GROWERS' ASSOCIATION

CONTENTS

PRICE 2/6

THIS BULLETIN IS CONFIDENTIAL TO MEMBERS

THE MUSHROOM GROWERS' ASSOCIATION

NEW MEMBERS

Since 30th SEPTEMBER, 1947

★

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	D. H. Walker, Cattle Dyke, Gorefield, Nr. Wisbech.
HANTS.	Lt.-Col. S. E. Hibbert, Parham House, Alresford.
	W. J. Trusler, Pack Lane, Hempshott, Basingstoke.
HERTS.	T. Rochford, Thos. Rochford & Sons Ltd., Turnford Hall Nurseries, Nr. Broxbourne.
LANCS.	G. S. Gainford, 32 South View, New Barns, Barrow-in-Furness.
LONDON	J. Marchlewski, Marchlewski & Son, 10 Harold Road, S.W.1.
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	Dr. R. G. Woodsend, Valley Farm, Brancaster Staithe, King's Lynn.
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SHROPS.	F. H. Austin, Burley Dam, Whitchurch.
SOMERSET	T. B. Douglas, Manor Farm, Misterton.
SURREY	R. N. F. Whalley, Birtley House Gardens, Bramley.
YORKS.	W. S. Atkinson, Reinton, Rein Road, West Ardsley.

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H. R. Goodman, Delamere, Concordia Avenue, Upton, Wirral, Cheshire.
G. W. Darnes, Fen Mushrooms Ltd., Bourne, Lincs.

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McG. Bulloch, Villa Aziz, La Tour de Salvagny (Rhone), France.

NEW HON. (ASSOCIATE) MEMBER

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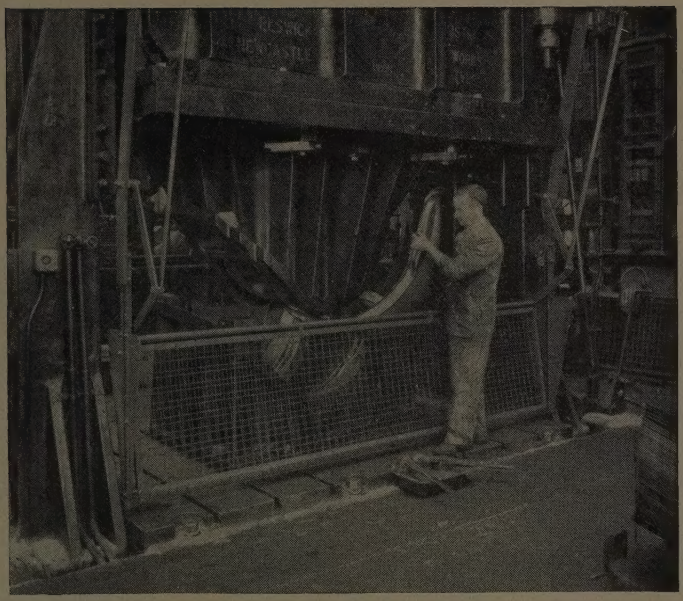
John Thornton	107 Portland Road, Waverley Street, Notts.
W. Young	Ivy Cottage, Washwater, Newbury, Berks.
K. J. Kakolewski	19 Langley Way, Watford.
Lt.-Col. G. E. Adie, M.B.E.	c/o Lloyds Bank, New St., Birmingham.
Lt.-Col. C. W. Ridley	Central India Horse, Ahmednagar, Deccan, India.



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THE

JANUARY 1948

BULLETIN No. 10

OPTIMISM

A NEW YEAR MESSAGE FROM OUR CHAIRMAN

I realised at our Second Annual Meeting that the M.G.A.'s biggest success to date was the destruction within the industry of individual isolation and prejudice and the creation of a spirit of co-operation and mutual assistance.

The lively tone of the meeting was a very good augury for the coming year, a year of special difficulties and problems for members and Association alike.

I would like to make one or two points to the industry as a whole.

The pessimist sees difficulties in opportunities, while the optimist makes opportunities out of difficulties. I suggest that mushroom growers be optimists and force opportunity out of the many practical difficulties that beset us. Despite taxation, frustration and local or national discouragement, which tend to make us slacken beyond a point, let us go all out for higher and quicker crop records. Let us show the country what home production can do and thereby greatly enhance our chances of reversing frustration. Moreover, if we aim at high production now, the sustained effort required will keep us fighting fit for some future time when low crops at low prices would put us out of business.

We have as an Association literally worked wonders in two years, not only among ourselves but in our relation with others. Co-operation between growers within the Association has not harmed us individually, much to the general surprise. We do not cut each others throats as we feared. But co-operation with those who help to control our destiny is vital to our continued success. I foresee much more co-operation between growers and Government, whether this is via the N.F.U., the N.A.A.S. or any other body. I look optimistically to a time not so far distant when the Government will come to a greater realisation of how much mushroom growers can help the country at small national cost.

EDITORIAL AND ADVERTISEMENT OFFICE :
MUSHROOM GROWERS' ASSOCIATION, YAXLEY, PETERBOROUGH

Realising this they will, I believe, give us more help to expand with materials which are available and will give high backing to our applications for licences, etc., so that we may give the people more of a food which is becoming officially recognised for its utility and variety values. Whatever our political leanings let us work and co-operate in such a way that Officialdom is bound by our very energy to take notice.

Finally, if no one has lost by joining the Association, can it be that none has gained? I don't believe it. We are proving it is possible to have mutual help without loss of individuality. We must tell this to the non-members. If we can show them out of our own experience that they have nothing to lose and much to gain, they will join us. Their gain will be ours too.

ITEMS OF GENERAL INTEREST

Cold-Frame Cultivation. Dr. Cecil Treschow describes in the Danish publication *Friesia* a method of growing mushrooms in cold frames. The frames which should be situated in the shade with some hours of morning and evening sunshine only, should be 3 feet wide, the wooden boards on one side being 1 foot high and on the other 2 feet. A covering of asphalt paper on a wooden framework should be provided and the frames must stand on firm ground surrounded by a trench to drain off the rain. The compost should be made into beds in the early part of June. A yield of 2 lb. to the square foot could be anticipated. (*Extracted from English Summary in the Review of Applied Mycology, Sept.*, 1947.)

Why Standardise? Standardisation is the first need of precision growing, suggested Mr. J. Newell, Assistant Curator at the John Innes Horticultural Institution, in July. He knew that many growers disliked the word—so formerly did they at the Institution – but they had come to realise that standardisation meant simplification. (*Fruit Grower*, 31.7.47.)

Tinned Mushrooms Imported. The *B. & G. Review* reported in September that recently the Canadian Pacific express freighter *Beaverburn* arrived in Liverpool with a cargo which included 14 tons of tinned mushrooms!

Bulletins may be bound. Our printers, Messrs. W. S. Maney & Son, are now able to bind the four 1947 issues of the Bulletin for members who desire to have their copies permanently preserved.

Nicotine in short supply. There will be a marked shortage of nicotine in 1948, warns Mr. C. E. Hudson, Deputy Provincial Director of the N.A.A.S., and Hon. Member of the M.G.A.

Infested, please! Since soil does not become infected with nematodes any more than a lake becomes infected with fish or weeds, but merely infested, soil fumigants are therefore not used as disinfectants, but as disinfestants. A. G. Newhall, of Cornell University. (*Soil Science, January*, 1946.)

The late Mrs. Atkins: Mr. Fred. C. Atkins thanks those members who have expressed sympathy in the loss of his wife on 3rd December, and asks to be excused from personal acknowledgment. (Mrs. Atkins acted unofficially as Secretary of the M.G.A. during her husband's illness in 1946.)

MUTUAL AID

Members Ask Your Advice

Please send replies to the Editor, M.G.A. Bulletin

Q 66. What demand is there for mushroom stalks?

Q 67. Have you any details regarding the control of long-legged mite?

Q 68. Instead of our beds cropping in the normal way, they have been covered with pin-heads which have withered and died. Eventually the beds cropped in the normal way. What is the cause of this?

Q 69. Have you any information regarding the growing of mushrooms in chemicals and water?

Q 70. I have particulars of a " Molonizer-Oxonian " unit which purifies the air and produces concentrated oxygen. Would this be beneficial in mushroom houses, and has anything of this nature been tried by mushroom growers?

Q 71. What would be the result of attempting to grow mushrooms in manure where the horses are bedded with wheat straw and fed entirely on either lucerne or clover hay, to the exclusion of any other fodder? Would an enhanced depth of bed off-set this irregularity?

Q 72. Can you tell me where I can get 98% Nicotine for fly control, also Pyrethrum liquid for use as a spray, and what sort of a gadget does one use for spraying this on, and where can it be obtained?

Answers to Previous Questions

The purpose of this Mutual Aid Section is to provide an opportunity for members to seek the advice of their fellows. The success of the section depends entirely upon members themselves.

Q 55. *I had a battle with my last crop over Dactylium dendroides. Now, every time I see a cottony growth I nearly have heart failure. If you could help in any way to prevent or control this disease, I would much appreciate it.*

Whilst Dactylium dendroides is usually the penalty for indifferent composting or trashing of the beds, from my costly experience I am of the opinion that some soils are more prone to it than others. On this farm the disease has been successfully combated by the following methods: (1) Thorough steam sterilization of the soil; (2) Maintenance of a very moderate and steady temperature; (3) Enhanced ventilation. (H. H. FELL.)

Q 56. *We used to grow in " bunks " made of bituminous felt. Last year we replaced the felt with corrugated sheets. Our next crop simply faded away, after showing great promise. Had the corrugated sheets any effect on the growth of the mushrooms?*

I know several growers who use corrugated iron sheets for bed boards and understand that although the spawn does not grow right up to the metal there has been no noticeable affect. One or two growers prefer to lay a thin layer of straw between the compost and the corrugated sheets, but I personally feel it would be safer to run a length of Sisalkraft paper over the sheets before filling. (F. C. ATKINS.)

Q 57. *We have a mushroom shed divided into three bays. There is no partition between the bays. The first bay has proved disappointing, and we wish to clear it out and put in fresh beds. Can we sterilize it with formaldehyde, prior to re-filling, without damaging the beds in the other two bays?*

In my opinion this would amount to confusion. Firstly, the clearing out process would disseminate contamination spores throughout the rest of the shed. Secondly, it would be impossible to thoroughly sterilize, as this, if done properly would kill all fungi, including the mushrooms in the adjoining beds. Thirdly, the presence of the older beds would prevent peak-heating. There would be a re-infestation from the old beds to the new and vice versa. It would be better to leave the old beds and clean out together. (H. H. FELL.)

Q 58. *Could you let us know the address of the Institute of Heating and Ventilating Engineers, and also inform us of the address of any suppliers of Oil Burning Units?*

The address of the Institute of Heating and Ventilating Engineers is 72 Victoria Street, London, S.W.1. (DR. R. L. EDWARDS.)

Q 59. *Could you tell me if there is any limit to the interval between spawning and casing? Does one wait until the growth of spawn has actually commenced?*

Many growers leave their beds uncased for a month, and add the lightest mist to the surface before doing so, but only if more than a quarter of an inch has dried out. (F. C. ATKINS.)

Q 63. *Can you give me a typical analysis of straw?*

Crop	Nitrogen	Phosphorus (as P_2O_5)	Potassium (as K_2O)
Spring Barley	·6 (·5–·8)	·2 (·15–·3)	1· (·8–1·6)
Spring Oats	·5 (·3–·8)	·2 (·15–·3)	1·5 (1–2)
Winter Wheat	·5 (·3–·8)	·15 (·1–·2)	·75 (·5–·21)

(R. DUTHY).

SYNTHETICS SOON ?

According to J. W. SINDEN it will soon be safe to introduce synthetic compost into the mushroom (*Psalliota spp.*) industry. One large producer is extending his production as a result of the yields obtained in large-scale trials. Finished compost containing 1·8 per cent. potassium, corresponding to an addition of 14 lb. potassium chloride per ton to a mixture of two-thirds maize fodder and one-third straw, gave more mushrooms than a compost containing 1·6 per cent. Adding more potassium had no further effect on yield. Ammonium nitrate may be replaced by calcium cyanamide on an equivalent nitrogen basis. Optimum calcium cyanamide concentration was 30 lb. per ton of dry mixture. Prepared in ricks consisting of 8 tons maize fodder and 5 tons straw, the synthetic compost yielded as well as horse manure. It was easier to handle and cheaper.

—*Review of Applied Mycology, May,* 1947.

ADDITIONS TO THE LIBRARY

Dr. E. B. Lambert has generously presented to the M.G.A. Library copies of his papers on Studies on the Relation of Temperature to the Growth, Parasitism, Thermal Death Points and Control of Mycogone Perniciosa; Normal Sporophores in Monosporous Cultures of Agaricus Campestris; Mushroom Disease known as Bubbles controlled by exclusion and eradication; Two New Diseases of Cultivated Mushrooms (Rose Comb and Truffle); Normal Mushrooms from Artificial Manure; A New Truffle in Beds of Cultivated Mushrooms (with W. W. Diehl); and Plaster Moulds occurring in beds of the Cultivated Mushroom (with Vera K. Charles). We also gratefully acknowledge receipt of copies of "Handbook of Mushroom Culture" and "Modern Spawn Making," presented by the author, Dr. A. M. Kligman; Comparisons of Mushroom Culture (in Danish), by the author, Dr. P. J. Bels; "Book of the Mushroom" (A. Defries), presented by Mr. Stanley Middlebrook. We have purchased copies of Dr. J. W. Sinden's Synthetic Compost for Mushroom Growing (further studies), Countess Morphy's Mushroom Recipes.

A Mushroom Grower's Diary

4th September—*I have been variously described by locals as The Mushroom King; The Mushroom Magnate; Lord Mushroom; THE Mushroom Expert, etc. How I laugh! For four consecutive months my weekly average from 12,000 sq. ft. has been 159 lbs.*

6th September—*Two months ago a flight of experts descended on my stromas, dying pinheads, non-production. They told me* (a) *my soil was too fine, tending to "bind" too much and* (b) *my spray was too heavy (though it was what I was pleased to call my "light mist" spray). I "listened humbly to the experts." Still no improvement. Gloom prevails. I decide on the other extreme and abandon the so-called "too heavy" spray in favour of my heaviest rose. I shall use this daily. I now wait to see whether I shall be "the late mushroom grower.*

18th September—*Motto for to-day:—To-morrow's results give the lie to to-day's "certain solution."*

23rd September—*The sign in the Sugar Factory Yard at Peterborough emphasises the need for tidiness as a means of reducing accidents. A slight twist to the meaning of "safety"—and what perfect advice to all mushroom growers.*

27th September—*From this month's "AGRICULTURE." To restore the structure of the salt-sick soils of the Netherlands, resulting from sea-flooding—natural and Nazified—large quantities of imported gysum are issued to farmers. Gypsum "turns out the Sodium and replaces with Calcium . . . . . thus shortening the soil recovery by three to seven years . . . . . "*

6th October—*One thing I can say—sterilization of my soil is the complete cure for Mycogone. I wish control of other diseases were as simple and sure.*

9th October—*I hear of a grower who is finding clumps of mushrooms growing DOWNWARDS through the paper and wire netting that he uses for beds. These mushrooms are in every way normal.*

14th October—*It looks as though the experts were wrong. Heavy regular waterings are now developing pinheads and transforming stromas into healthy mushrooms.*

30th October—*Owing to shortage of moist spawn I am forced, with many misgivings, to use dry.*

8th November—*I have now proved to my satisfaction that a light sandy soil will grow a heavy crop of heavy mushrooms. The secret lies in maintaining sufficient moisture at the base of the casing.*

18th November—*I am amazed at the very small amount of soil that comes away with large clumps of mushrooms taken from outdoor beds. Trashing after an average flush is almost negligible. A clump weighing 2 lbs. has removed only about 2 ozs. of soil. No stumps at all.*

24th November—*The dry spawn isn't moving yet. The compost had a moisture content suitable for moist spawn. What do I do? I am afraid heavy spraying will tend to dilute the top layer of the compost. This layer is, I fancy, the vital part after soil has been applied. I would like to add a stimulant in the water to brighten up the top layer but what can I use? I'm afraid we are in for a crop failure.*

27th November—*Second Annual Meeting. I think in future these meetings should extend over two days. There is not enough time for informal discussion of practical problems.*

30th November—*Dr. Hope Robertson, M.B., Ch.B., in to-day's "Sunday Express" discusses under the heading "How to cure that tired feeling" how we can become really healthy and more energetic. People who worry and develop nervous disorders should know the foods most beneficial to them. He then gives the vital foods as onions, potato skins, olive oil, fresh pineapple, globe artichokes and—MUSHROOMS.*

1st December—*Picked 180 lbs. of frozen mushrooms from outdoor beds, so frozen that they can hardly be broken up by the hand. They made top price!*

5th December—*Housewife to Salesman: "Wot!—none for me either? Where do mushrooms go in winter time?" Salesman:—"Export, Madam."*

COMPETITION FROM

Pseudobalsamia Microspora Diehl and Lambert

Alternative Names :

Truffle, False Truffle, " Calves' Brains."

Characteristics :

To naked eye a thick cream-to-white mycelium in compost and/or casing, not unlike mushroom mycelium, develops rounded cream-coloured fruiting bodies which fuse together to form irregular lobed masses likened to miniature calves' brains or shelled walnuts. Can be mistaken for deformed " pinheads," especially when below surface. Masses of ascocarps sometimes 1½ inches long. As they mature they turn reddish brown, decay, and spores contained in them are released. When large quantities of these spores are liberated they may be detected as buff-coloured patches. Chlorine-like odour reported from badly-infected houses.

Original Source of Infection :

Almost certainly the surface soil.

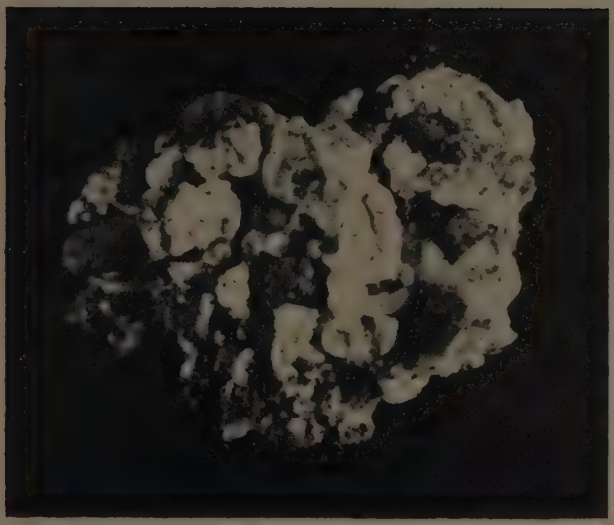
Prevention :

Remember spores are not killed by usual composting temperatures —can withstand 180° F. for at least 5 hours. Do not compost on earth floor. Do not use contaminated soil—either for mixing with compost or as casing. RUN SPAWN AT 60° F. Discourage carry-over by passing blowlamp over surfaces of boards if once in contact with infected areas ; then soak boards and house-structure with double-strength fungicide to kill mycelium. Avoid making beds too wet or tight. Give adequate ventilation.

Control :

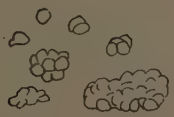
No satisfactory means yet devised. No normal fungicides known to kill spores. If infected area small, carefully dig out and burn together with bed within 3ft. radius. If infected area large, separate from healthy bed by channels and dry off, carefully removing and burning visible fruit-bodies. Exercise great care not to carry mycelium from infected to free areas. Keep down flies—they can spread the trouble.

—Fred. C. Atkins and C. J. La Touche.



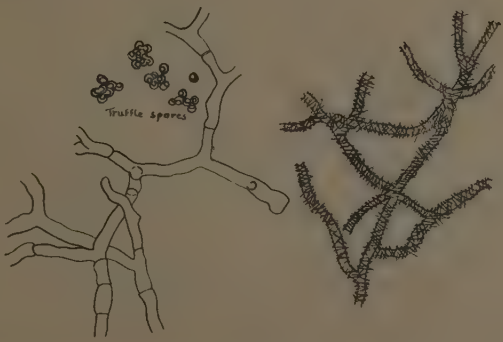
Masses of ascocarps, as seen by the naked eye.

Single and compound fruit bodies



Truffle mycelium (on left) is smooth and well-defined

Mushroom mycelium (on right) generally becomes furred with calcium oxalate crystals.



Semi-diagrammatic microscope drawings with camera lucida x250

A RETAILER'S POINT OF VIEW

By S. A. NEWEY

I have had twenty years' experience as a shop-keeper, during which time I have sold large quantities of mushrooms all the year round, and I have been asked by the Editor to pass on my conclusions, for what they are worth.

I feel certain that all growers will agree when I say that marketing mushrooms comes second only to the actual growing, and by marketing I mean the whole system involved after the crop leaves the farm.

It was not a long time ago that the public were reluctant to buy "forced mushrooms," preferring the out-door wild mushroom. That position is now altered and they have been educated to buy the all-the-year-round cultivated mushroom. I say educated because no one can force the public to buy what they do not want. Tomatoes when first introduced went through this stage, and it is due to the improved quality and packing that they are now an important food product to-day. The lesson is obvious: improve your quality even at the sacrifice of quantity, for the people who buy mushrooms know what they are doing and are prepared to pay for the best. You can advertise on any scale you like, but in the long run it is what is in the bag that counts! The fact that the public are now mushroom-minded is a great point in our favour.

A great many growers spoil their samples by indifferent packing. I do not mean size-grading as much as mixing first and second quality grades together. A retailer valuing mushrooms in an open market judges by the lowest grade present, because he has to sort them before retailing them. This means time, labour and money to him. Good grading pays dividends, and a good grader soon gets known and his crop meets with a ready sale. Again it is what is in the bag that counts!

If possible present your produce clean, and line your chips with WHITE TISSUE, and use 2 lb. chips. One pound and ½ pound chips do reach the public, but the elaborate printing on 2 lb. chips is a waste, because the public do not see it. The extra long stalk used by some growers is a waste also, as the increased weight is out of proportion to the decrease in value.

If you have found a reputable wholesaler, keep to him. I know that returns are not always satisfactory to the grower, but if you can foster mutual trust it is a good thing. A wholesaler, knowing he can depend on you, will try to work up a clientele for your produce, and get a good price thereby, but he does expect the grower to stand by him in bad times.

Market prices are ruled by supply and demand and this means that it does not matter who handles your produce, but wholesalers do not like a grower to send to two or three firms in the same market. Playing one firm off against the other, the grower will find that he is the one to go to the wall when times are bad.

I have turned commercial grower, of course!

ABOVE OR BELOW GROUND?

McGregor Bulloch summarizes the disadvantages of Cave Culture

It has come to my notice that, in view of the restrictions existing in Great Britain to-day, a number of established as well as would-be growers are considering seriously the cultivation of mushrooms underground in order, presumably, to save heating bills, or to avoid the difficulty of obtaining materials and fuel, or because their insulation is not proof against such a summer as that of last year.

My advice to these growers is, if you are intending to grow only in a small way—go ahead ; but if you wish to make a big thing out of it—don't !

Mushrooms need the following physical conditions for good growth. Ventilation ; an even temperature around 55-60° F. ; a fairly high humidity ; and freedom from insect pests and diseases. Of these, temperature and humidity are usually most suitable in underground sites, and thus artificial heating is dispensed with, as well as any worry about beds drying out in unusually hot weather.

Ventilation, however, is the main problem, and one would be extremely lucky to find the right aeration control in an underground site. Here then is the first considerable expense in machines and labour—the provision of suitable ventilators—either fans or shafts, together with a system of light doors to control the ventilation in the various galleries (if a large plant is envisaged). These doors are necessary since the mere installation of an inlet and an outlet for the air will not ensure the air being changed in every quarter ; the air must be removed from each gallery in turn, unless of course, there is only one gallery or cave to be dealt with.

With regard to diseases and pests, it will be remembered that one of the most efficient methods of pest and disease eradication is the use of " peak heating " which, if maintained for a few days, will kill the spores of most diseases and bring insects to the surface of the beds, where they can more easily be exterminated.

" Peak heating " underground is absolutely out of the question, so that one is obliged to disinfect and fumigate with chemicals alone. If the galleries communicate with each other, as they frequently do, great difficulty is experienced in using such chemicals as sulphur, formalin, etc., when there are growing mushrooms adjacent to the new beds. Again, when beds are exhausted, efficient disinfection is very difficult, since noxious vapours have to be dispersed over growing mushrooms a short distance away.

Dealing with other aspects of mushroom cultivation, unless shelf beds are installed, ridge-beds are wasteful of space and involve much more effort in their construction and maintenance, the unfortunate workmen being in a stooping position for the greater part of their time. Also, unless a moisture-proof electrical installation is used, portable lamps must be used, adding still further to the difficulties of the workers.

The above may seem a one-sided and unduly harsh condemnation of the conditions experienced in underground cultivation, but the difficulties are real and have to be faced.

We know that when a mycologist makes a pure culture of a fungus his constant care is the preservation of strictly aseptic conditions. To my mind, the same conditions prevail in the cultivation of mushrooms in special houses above ground. The sterilization of the medium in which the mycologist grows his fungus cultures is paralleled by the " peak heat " given to prepared manure, and from that point one struggles constantly to preserve clean conditions, with the slight advantage that invading organisms are inhibited to a certain extent by a good spawn-run. In underground sites one loses that powerful weapon, the " peak heat," which in addition of course is a valuable means of " sweetening " the compost before spawning.

Finally, there is our old friend " site contamination." Although the writer's personal opinion is that site contamination can easily be prevented by efficient disinfection, such disinfection is not always possible in caves. In the majority of cases, therefore, the time arrives when there is no other alternative but to shut up sections of the cave, or to disinfect the workings *en masse*, a more or less costly procedure according to the size of the installation.

If, after these observations, there are those who must have a try at underground cultivation, one can only recommend a diligent search for a site which, *first and foremost*, has good ventilation, and that beds in tiers and NOT on the ground are used. To those whose reason for abandoning house cultivation is the fear of prolonged hot weather, I would add that during the recent unusually hot summer, I met a grower in France who, with a constant temperature of 58° F. in his caves, was producing only 60 lb. of mushrooms per day from an installation using 80 tons of manure per month.

La Tour de Salvagny, France.

EXTRACTS FROM THE M.G.A. BOOKSHELF

DISEASE IN ITALY

Some time ago there was news about the activities of mushroom growers in France. Here for a change is something from Italy - a paper by G. Borzini : " On the Fungi most injurious to our cultivation of the edible mushroom." (Boll. Staz. Pat. Veg. Roma, 1942.)

Within the compass of some 30 pages previous literature on the problems of mushroom disease and fungus competitors of mushrooms as they affect other countries is reviewed. This is followed by a short account of similar problems in Italy, making a total of some 40 pages.

In assessing the value of this work from the British point of view it must be borne in mind that in Italy mushroom-growing is practised in caves and underground quarries, as is the case in France, so that naturally environmental conditions differ from our own.

In the past much damage to crops was caused by *Mycogone*, but recently acquired knowledge has established the wide occurrence of

Verticillium Malthousei Ware, and it is thought that much of the trouble formerly attributed to *Mycogone* was most probably due to this species of Verticillium. The reason for this misinterpretation lies in the fact that the symptoms shown by mushrooms which are attacked at an early stage of development superficially resemble in many cases those produced by *Mycogone*.

Pseudomonas Tolaasi, the cause of "bacterial blotch," is next on the black list. However, these diseases have been much less in evidence during recent years, owing to the application, on many farms, of scientific measures which include adequate ventilation, lowering the temperatures, and control of insects.

Amongst the bed competitors, both white and brown plaster moulds are of wide occurrence, but are not considered to be a menace. Their presence in the beds is attributed to defective composting, particularly in regard to the low maximum temperature levels reached in such cases. The usual green moulds, *Penicillium*, *Aspergillus* and *Trichoderma*, are also mentioned as occurring when the compost is excessively damp or when the air temperature is too high. Of particular interest is the mention of a greyish green mould, by name, *Aphiotrichum*, which occurred extensively during 1941-'42, and is considered to be harmful to the development of mushroom mycelium. As far as I know, it has not been reported in other countries. The omission of *Truffle* from the list of bed competitors is interesting in view of its prevalence in this country and the United States.

Local treatment with 3-4% formaldehyde or benzine vapour is advocated if disease has become established, but greater stress is laid on the more efficacious practice of preventive measures. These are considered under the following headings :—

1. **Optimum environmental conditions.** Mushroom culture may be undertaken between 59° F. and 66° F., such as occurs in the caves used for the purpose.

2. **Disinfection of the composting site, the mushroom caves and the casing soil.** The composting site as also the mushroom cave should be sprayed with a mixture composed of 60 lb. of lime only barely slaked in about 22 galls of water, about 2 galls. of 20% copper sulphate and about 4 lb. of hypochlorite of lime suspended in another 2 galls. of water. The casing soil may be sprayed with 1% hypochlorite of lime.

3. **Fermentation of the compost.** Three turnings should be performed in the turning shed at intervals determined by the rise and fall of the temperature and a fourth in the mushroom cave.

4. **Spawning.** Spawning should be carried out after the fourth turn when the temperature of the bed descends to between 68° F. and 77° F. in the outer part of the bed.

5. **Ventilation of the mushroom cave.** Slow continuous ventilation controls the invasion of beds by fungus competitors.

6. **Complementary measures.** To prevent the spread of disease by insects the daily picking and destruction of diseased mushrooms is necessary.

A useful bibliography of some forty-eight titles is appended and covers most of the important literature on mushroom disease and kindred problems. **C. J. LaT.**

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Clitopilus Cretatus as an Invader of Mushroom Beds

By Dr. W. M. Ware

In December, 1934, a certain fungus invading indoor Mushroom beds on a farm in east Kent came to the notice of the writer. The beds were situated in a large, specially built Mushroom house (one hundred and twenty feet square) which was constructed of corrugated iron lined with match-board. Water-pipe heating was provided and the floor was made of concrete. Of thirty-seven beds running the whole length of the house, six were covered with tufts of a delicate fleshy fungus which projected from the casing soil, on the top and sloping sides of the ridges, in the form of small, white brackets which were

FIG. 136.—CLITOPILUS CRETATUS
From a photograph (natural size) showing the lateral position of the stalk, the decurrent gills and the involute margin

often densely crowded and were commonly superimposed (Fig. 136, top left). This fungus was a Toadstool and therefore was to be distinguished from mould-like growths or from cup fungi, such as Peziza vesiculosa, which are sometimes found on Mushroom beds. It differed, however, from the popular conception of a Toadstool in that the cap was irregular and the very short stalk was commonly attached at one side (Fig. 136, bottom left; Fig. 137, Nos. 4, 5, 6), giving to the tufts the appearance already noted of small brackets projecting from the soil.

The largest specimen collected measured 47 mm. in diameter, but the majority only 8 mm. to 30 mm. The caps, which were pure

white in colour, with surface smooth and slightly shining, were concave in mature specimens, with central stalk (Fig. 137, No. 1), but were occasionally convex; the margin was turned over towards the gills ("involute") Fig. 136. The stalk was always very short (4 mm.) and slender (2·5 to 3 mm.), and was slightly woolly or quite smooth at the base; it was commonly at or near the margin of the cap (Fig. 136 and Fig. 137, Nos. 5, 6), but in certain very perfect and mature specimens it was central. In these there was a tendency for the cap to become so concave and to turn up to such an extent that it split into two parts (Fig. 137, Nos. 1, 2). The gills, which were narrow and very decurrent, were at first white but were later pale fawn or pale biscuit-brown in colour. When the fungus was kept in a still and moist atmosphere and spores were able to accumulate, the gills became tinged with a faint pink colour. Spores collected in quantity by allowing them to fall on a sheet of white paper were distinctly pink or rose-coloured. With the microscope they were found (Fig. 138) to be oval (broadly elliptical) and either centrally or obliquely apiculate, the minute apiculus representing the place of attachment to the sterigma. They measured 6·0 to 8·5μ × 3·5 to 4·5μ.

Owing to the profusion of the fungus on the ridges, it was obvious that it was to be classed among the active competitors of the cultivated Mushroom. The beds had been made in the first week of September, spawned a fortnight later, and cased ten days after that. On two of the ridges it had made its appearance before the first Mushrooms were seen, and it is noteworthy that these beds had been slower in cooling and had been cased immediately after being spawned; on the others, to which the casing soil had not been applied until a fortnight after the spawn was planted, the Mushrooms were the first to appear. The casing soil had been dug from the surface and had not been steamed. The crop had started in November and although it was poor and apparently crowded out by the invader at the time the house was visited early in December, the grower did not consider at a later date (February, 1935) that the quantity of Mushrooms had been much reduced. Obviously, however, the fungus was an unwelcome visitor, for besides competing for food and space, it rendered picking more difficult and necessitated extra work in removing it from the beds and burning it. In the casing soil, the mycelium of the fungus was plentiful and could be distinguished from that of the Mushroom, but in the compost it was not possible to make the distinction so easily, and the depth to which it had penetrated could not be ascertained. It was thought by the grower, however, that the invading mycelium was principally in the casing soil, and that it extended only a few inches into the bed. No characteristic smell in the infected compost was noticed. Owing to the fact that the fungus also occurred in an adjoining house and on beds which had been cased with soil from the same heap as had been used in the first house, the grower suspected that the soil was the source of the trouble. He considered that so general a distribution of the fungus throughout the length of the ridges could hardly have been

possible if it were supposed that the invader had been introduced with the compost.*

In France, the fungus invaders of Mushroom beds in the great caves near Paris were investigated by Costantin so long ago as 1892-1894, and a certain condition of the compost, at that time known to growers as "Le Chanci"†, was discovered by him to be due to the presence of mycelium of either or both of two Toadstools which were identified for him by Boudier as Clitocybe candicans‡ and Pleurotus mutilus.‖

Clitocybe dealbata has recently been described in *The Gardeners' Chronicle*¶ as an invader of Mushroom beds in England and, on Costantin's own statement, it may well have been this species, and not C. candicans, which he found responsible in part for "Le Chanci." There is evidence also in Costantin's description of his second fungus that he had some difficulty in understanding Boudier's identification and, in the opinion of the present writer, the fungus found by Costantin was probably not P. mutilus; the description that he gives agrees perfectly with the English Mushroom bed invader now under discussion which has been identified as Clitopilus cretatus. The two fungi are similar in form§ but differ in the colour of the spores and unless a spore print is made while the fungi are fresh, they are apparently indistinguishable. The spores of C. cretatus are pink and those of P. mutilus are white. Lange,** in describing P. mutilus, mentions that he considers it to be probably the same as C. cretatus, while by other authorities the two are differentiated.†† By those who consider them to be one and the same species, it might be argued that in the immature state of the sporophore both the gills and the spores may be white in colour and that they only become pink in the later stages of growth. Coloured spores are certainly met with in some other species of Pleurotus.

Specimens of the English Mushroom bed invader were sent by the writer to Mr. Carleton Rea who, taking into account the pink colour of the spores, identified the fungus as Clitopilus cretatus, B. and Br.

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* In support of this argument it should be remembered that the manure from which the compost is made reaches temperatures between 140° and 170° F. for days at a time during a period of three or four weeks and all parts of the heap are well mixed in the thorough turning process which is repeated four or five times. Although some parts of any of the actively fermenting consecutive heaps may be considerably cooler, the turning process would make it likely that spores or mycelium would at some time be subjected to the highest temperatures. It seems unlikely that the fungus would be in a fit state, if it was already in the compost, to grow vigorously throughout the entire length of several ridge beds. If on the other hand, the fungus were actually introduced in the compost, it would be reasonable to expect it to form points of attack only here and there.

† According to Costantin (*Comptes Rendus*, 114, 850, 1892), Chanci = Chancissure, a synonym of Moisissure, meaning Mould.

‡ Costantin, J., "Le Chanci, maladie du blanc de Champignon." *Bull. Soc. Myc. France*, 8, 153-161, 1892. Costantin was doubtful whether the species was C. candicans or possibly C. dealbata.

Costantin, J., "Note sur les Champignons appelés 'Oreilles de Chat.'" *Bull. Soc. Myc. France*, 9, 87-89, 1893.

¶ Buddin, W., and Ware, W. M., "Clitocybe dealbata as an invader of Mushroom beds." *Gard. Chron* XCIII, 246-248, 1933.

§ Compare the figure of P. mutilus (Fries: *Icones*, t. 88, Fig. 1) with that of C. cretatus (Cooke: *Illustr.* t. 375, Fig. B.). The writer is indebted to Miss E. M. Wakefield, Royal Botanic Gardens, Kew, for assistance in comparing the two fungi.

** Lange, J. E., "Studies in the Agarics of Denmark" in *Dansk. Bot. Arkiv.*, 1914, *et seq.*

†† Thus, Carleton Rea (*British Basidiomycetae*, 1922) distinguishes between C. cretatus (p. 311) and P. mutilus (p. 415).

Whether the two species are distinct or not, there can at least be no doubt that the present fungus is the same as that which was held by Costantin to be a cause of "Le Chanci." The French Mushroom growers at the end of the nineteenth century referred to the fructifications as "Oreilles de Chat" (Cat's Ears), because of their shape in outline. The name is singularly appropriate for C. cretatus and might well continue to be used.

Clitopilus cretatus, according to Carleton Rea,* occurs in woods and pastures and is uncommon in England; in the writer's knowledge, one or two specimens of a fungus, possibly the same, have been seen recently on Mushroom beds, but their identity was not determined. Mushroom growers, however, may be free from any feelings of alarm because the present extensive invasion of ridge beds is probably the first that has been recorded in this country and the fungus is rare. The chief interest in the occurrence undoubtedly lies in the circumstances attendant on the investigation forty years ago of "Le Chanci" in France and the recognition of "Oreilles de Chat" as connected with it.

In France and in other countries, before 1893, reliable spawn was not easily obtained and when Mushroom beds became invaded with a foreign fungus it was easy to make the assumption (as Costantin did†), that the planted spawn had contained the wrong mycelium and had been responsible for the introduction. It would seem, in fact, that at that time "Le Chanci" was important as constituting false or contaminated spawn; any subsequent effect it might exert by reason of its invasion was, of course, secondary. In order to come to some conclusion as to the losses resulting from the presence of different fungus invaders, Costantin and Matruchot‡ attempted to obtain contaminated spawn or mycelium (procurer des blancs atteints de maladies diverses) and, having had some measure of success, they carried out trials by planting both "diseased" and healthy spawn in Mushroom beds. In the case of the blanc chanci‖, they found (*loc. cit.*, p. 297), that neither this nor the healthy spawn spread far from the place of planting, but that the spawn with "Le Chanci" produced a very small crop in comparison with the healthy spawn. The observation of growers, however, had been that "Le Chanci" had a tendency to spread far in the compost.

In the eyes of Costantin, then, a clean bill of health for the spawn was of great importance, and in his writings he describes how Mushroom spawn was obtained at that time. According to him,¶ the French growers, when they first used caves at the beginning of the nineteenth century, had discovered that the same mycelium could hardly be used more than three times before it became exhausted and virgin spawn had to be procured. This was bought from market gardeners who made

* Rea, Carleton. *Loc. cit.*, p. 311.

† Costantin, J., *C. R. Acad. Sci.*, 114, 849, 1892 (Vert de gris) *Bull. Soc. Myc. France*, 9, 88, 1893 (Oreilles de Chat), *Bull. Soc. Myc. France*, 8, 155, 1892 (Chanci).

‡ Costantin, J., and Matruchot, L., "Recherches sur le Vert de gris, le Platre et le Chanci." *Rev. Gén. Bot.*, 6, 289-300, 1894.

‖ Spawn contaminated with either or both Clitocybe candicans and Pleurotus mutilus.

¶ Costantin, J., "Le Chanci, maladie du blanc de Champignon." *Bull. Soc. Myc. France*, 8, 154, 1892. The cause of exhaustion was supposed by Costantin to have been due perhaps to the *Mycogone* disease or to prolonged culture in the darkness of the caves.

up special beds of horse droppings and chaff and secured in the mixture a natural growth of mycelium or planted in the bed some non-exhausted mycelium from the caves, in order to re-invigorate it.* The Mushroom growers then bought as spawn the material of this special bed which was sold in growing condition or was dried as flakes. It had evidently been discovered that true virgin spawn, preferable in some respects to the rejuvenated material described, could be found in autumn in the wild state, for in 1894, Costantin and Matruchot† express regrets that it was often scarce. They also record at the same time (1894) that growers were still in the habit of trying to raise as much as a third crop by re-running old mycelium because the true virgin spawn was so scarce. It is evident, though, that the market gardeners of Paris had, before 1870,‡ adopted the method of planting wild virgin spawn in their special beds for making flake spawn.

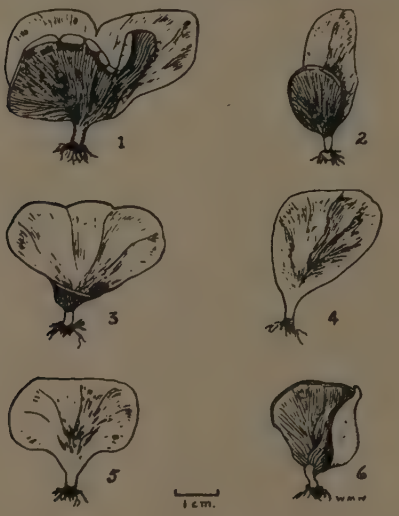

FIG. 137. — CLITOPILUS CRETATUS.
Drawings of some of the larger specimens showing (Nos. 1-3) the stalk more or less central; splitting of the cap (Nos. 1 and 2) into lobes; lateral stalks in Nos. 4, 5, 6.

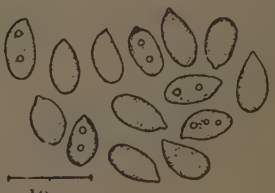

FIG. 138
CLITOPILUS CRETATUS
Mature spores as seen with the twelve-inch objective of the microscope. Outlined by camera lucida

The spawn used in France, then, before 1893, may be said to have consisted of (1) old mycelium from an exhausted bed replanted so many

* This process of rejuvenation is mentioned by Costantin (*loc. cit.*, p. 154, 1892) and by Robinson, W. *Mushroom Culture*, London, 1870, p. 73).

† Costantin, J., and Matruchot, L., "Recherches sur le Vert de gris, le Plâtre et le Chanci." *Rev. Gén., Bot.*, 6, 299, 1894.

‡ Robinson, W., *Mushroom Culture: Its Extension and Improvement*, London, 1870. The author (pp. 24-29 and p. 75) describes this method of propagating wild virgin spawn for the production of flake-spawn in France. He mentions that flake spawn had recently been introduced for the first time to England Incidentally, he denies that old bed material was used directly as spawn in France.

as three times ; (2) wild virgin spawn, if obtainable, planted directly in the beds ; (3) flake spawn, fresh or dry, purchased from the market gardeners, and produced by pulling to pieces special beds of compost in which had been " run " either (a) old mycelium from the caves (" rejuvenated "), or (b) " spontaneously arising " mycelium, or (c) wild virgin spawn.

Against spawn in general, as it was then made, Costantin levelled the accusation that it introduced or perpetuated diseases. So deeply was he concerned with the impurity of the spawn that he does not appear to have considered until 1894* the possibility of the introduction of fungus invaders by any other means. Even when, in 1893, he and Matruchot† announced to the Académie des Sciences their discovery of the method of making pure culture spawn from spores of the Mushroom, the outstanding advantages of the new process were claimed to be firstly the suppression of diseases carried by the spawn itself, secondly that varieties of Mushroom could be selected, and thirdly, that spawn could be made available all the year round. The first of these was particularly emphasised (*loc. cit.*, pp. 71-72).

The occurrence recently in England of both the fungi constituting " Le Chanci " of Costantin is therefore of particular interest because pure culture spawn has been used in both instances, and it is certain that Clitocybe dealbata in 1933 and Clitopilus cretatus in 1934 were introduced to the Mushroom beds in Hampshire and Kent, respectively, by some means other than the spawn.

* Costantin, J., and Matruchot, L., " Recherches sur le Vert de gris," etc., *Rev. Gén. Bot.* 6. 293, 1894. The part played by the manure in introducing Vert de gris and le Plâtre is here considered.

† Costantin, J., and Matruchot, L., " Sur un nouveau procédé de culture du Champignon de couche." *Comptes Rendus Acad. Sci.*, 117, 70-72, 1893.

THE DECAY OF BEDBOARDS

In mushroom houses the bedboards are liable to rapid decay, and these also become infected with fungi such as *Fusarium sp.*, which are deleterious to the mushrooms. It is therefore most desirable that they should be treated with a preservative ; 1-2 per cent. copper sulphate solution has been used with some success, creosote and creosote diluted with petrol have also been employed, but cases of damage to the succeeding crop of mushrooms have been reported when the creosote contained a high proportion of volatile compounds or where it was applied only a short time before the compost was placed in the beds. Pizer and Glasscock (1943) carried out a series of laboratory tests to determine the effect of various wood preservatives on the succeeding mushroom crop, and concluded that solutions of copper sulphate and of the following proprietary wood preservatives, Green Cuprinol, Celcure and Triolith could be used with negligible risk of damage to the mushroom crop, but that further trials with creosotes of known composition were desirable. Western red cedar has proved very satisfactory for mushroom house construction, and no damage to the crop has been reported as a result of its use.

From Decay of Timber and its Prevention, by K. St. G. Cartwright and W. P. K. Findlay, of the Forest Products Research Laboratory. (*H.M. Stationery Office*, 1946.) 12/6.

THE FUTURE OF THE

"It's up to you!" s

Second Luncheon a

CLOSE ON 150 MEMBERS AND FRIENDS ATTENDED THE SECOND ANNUAL LUNCHEON (BUFFET STYLE, IN ACCORDANCE WITH MINISTRY OF FOOD RULING) AND ANNUAL GENERAL MEETING, HELD AT THE RESTAURANT FRASCATI, LONDON, ON THURSDAY, 27th NOVEMBER. MR. STANLEY MIDDLEBROOK (VICE-CHAIRMAN) PRESIDED IN THE ABSENCE ON MEDICAL GROUNDS OF THE CHAIRMAN (MAJOR C. P. WHITAKER).

THE CHAIRMAN FOR 1948

Mr. Middlebrook, after the luncheon, welcomed "such a marvellous gathering" especially in view of the fact that two or three years ago secrecy still ruled the Mushroom Industry. "Last year the code word of our meeting and work was RECOGNITION," he said. "We had, as it were, an official Go-ahead, something positive and definite. The operative word was Yea. This year I hope there is no significance in the initial letters N.A.A.S. I hope we are not going to have a lot of Nays! In other words, we do not want more restrictions." The M.G.A. had from the beginning backed up the N.A.A.S. and in the future the Advisory Officers would be of great assistance to the Mushroom Industry. It was true that they would have to learn something about mushroom growing before they could be of much help, and it had been one of the aims of the Executive Committee to try to introduce the Advisers to mushroom problems by inviting them to mushroom farms.

Mr. E. H. Gardener, Vice-President of the National Farmers' Union, proposed the toast of the National Agricultural Advisory Service, coupling with it the name of Dr. H. V. Taylor. The horticultural side of the N.A.A.S. had to be looked at against the background of progress made before the War. There was a steady piling up of interest

MUSHROOM INDUSTRY

Dr. H. V. Taylor

d Annual Meeting

and a wider realisation that technical knowledge was required by all and could be assimilated by all, and that led to the formation of the N.A.A.S. The result was that there was now at hand a great wealth of knowledge for those who cared to use it. The N.A.A.S. was not concerned with control to-day. Even during the War years the W.A.E. Committees stressed far more the technical side and advice rather than control.

" Quite unavoidably, the Service has had a slow start," Mr. Gardener continued. " Nevertheless it is getting over its initial difficulties, and up and down the country technical conferences are being held dealing with production, marketing and all sorts of problems. Dr. Taylor might consider the appointment of mushroom experts to solve the problem mentioned by your Chairman. In the meantime there is great benefit to be gained by contacts you make with your local Officer. I have seldom been round anyone else's holding where I have not learned something of value—and I expect that is your experience too. It is quite true that you may know more things on your particular subject than your local Officer does to-day. He has a vast range of subjects to deal with ; but the time may come when he will give you one bit of advice which will repay many times over all the things you have advised him on. I think that in the years to come the whole industry, and your industry, will benefit enormously by this technical advice that we shall have. There is great room for a wider spread of knowledge."

Dr. H. V. Taylor, O.B.E., D.Sc., A.R.C.S., Senior Advisory Officer, Ministry of Agriculture, in reply, said that when he joined the Ministry in 1913 more than half the mushrooms used in this country came from France. He thought the whole industry was not what it should be, and the industry felt likewise. " I began to frame plans, and it seemed to me that three things were needed by the Agricultural and Horticultural Industry," he said. " The first was research—we had not a single research station apart from Rothamsted, which was engaged in soil research. I thought that what we wanted was one research station for fruit, one for vegetables, one for crops grown under glass, and one for flowers. I have not at this moment lived to see these stations come into being, but we have lived to see a research station for fruit come into being at East Malling, and at Long Ashton one for glasshouse crops, and a decision reached to found a big research station for vegetable crops, and the Government have agreed to begin to build a big research station for glasshouse crops which will also deal with mushrooms.

" You may ask : Why pin so much faith on Research ? The answer is that every industry unless it progresses cannot stand still. It always goes back. It is always research that shows the road to progress. It is always research, with that stimulating fostering spirit, driving us along in the right direction. In every industry we have to see that research is always tackling our problems, clearing them up, keeping production up to producing man's requirements. Then we are always looking ahead instead of looking back."

The second thing he thought we had to have was an Advisory Service which could spread the knowledge gained. It was no good having a £40,000 a year research station unless the information and results were spread throughout the land to reach every grower in the industry. In 1913, when he looked round to see who were to act as advisers there were none. There must be advisers to link industry with research. They must bring the results of research to the industry, and (what is even more important) bring the industry's problems to the research workers.

" You know the problems you have—pests, the problem of what you can use when dung gets too scarce to use as your medium," said Dr. Taylor. " You must present such problems to the Advisers, who will carry them back, and they will have to be tackled seriously and energetically. The results will be carried back to you by the Advisers. The N.A.A.S. is going to provide that link—research going out and problems coming back. It is not half our problem, not ten per cent. of it, to go on to a grower's place and tell him how to grow mushrooms. That is the grower's affair ; he should be able to do that better than we can. Do not think the Advisory Service chap is to come to you skilled growers to tell you how to grow ; what he can do, when you get a problem, is to try and get it solved for you."

The third thing the Industry wanted was a teaching place where the expert skilled artisans, the industry wants could be taught the technique of growing. . . . . The Loveday Committee, which had heard some evidence from him, had definitely reported that the Horticultural Industry needed its own special horticultural institutes. . . . . " When we can get places like that in the country there will be somewhere for the sons of growers and others to go to be turned out skilled artisans," he added.

Dr. Taylor concluded : " When these facilities are here for research, advice and education, it must be your part to see that Mushrooms find their own and proper sphere in each. Let us take, for instance, a research station. A research station for glasshouse crops will be charged with the responsibility for dealing with mushrooms. It is up to you to see that there is a Mushroom Committee set up by the Governing Body of such a station and that that Committee is composed from the Mushroom Industry itself, and sees that your Industry's problems are really tackled. At the teaching centres which are going to be created it is for the Mushroom Industry to see that in the syllabus of instruction there is a course given on mushrooms. The Industry itself must push and organise and see that

DR. H. V. TAYLOR
O.B.E., D.Sc., A.R.C.S.

it happens. All that I can do is to be the architect, as it were, and provide the facilities for you to take advantage of. In the Advisory Service you have already taken action : you have asked us to see that we have people there to give advice on Mushrooms. We accept that, and will see that in each of the eight Centres there is a man to give advice on Mushrooms. He will keep in touch with research and with the Industry, and will be able to help both sides, take back your problems and pass on to you the results of research . . . . . "

"I congratulate the Mushroom Industry on being so much alive and so co-operative that such a large body can be brought together and talk as friends, so that the spirit of secrecy which used to prevail in the past has obviously disappeared." (*Applause.*)

Mr. Fred. C. Atkins, on behalf of the M.G.A., thanked the speakers. " I want to take this opportunity of thanking the N.F.U., and in particular their representatives here to-day—Mr. Gardener, Mr. F. T. Hussey, Mr. L. C. Madsen and Mr. H. R. Haynes—for all the support they have given us from the beginning. No longer is there any criticism of our decision to join the Union as a Specialist Branch. Dr. Taylor has always been co-operative and helpful ; I think he realised from the beginning that we were determined and realistic in our approach, and we sincerely appreciate his sympathetic reception of our various requests." (*Hear, hear !*)

Mr. Percy C. Major supported this expression of thanks, " the more sincerely because I have personally experienced the benefits of the N.A.A.S."

THE ANNUAL MEETING

Mr. Middlebrook, presiding over the Second Annual General Meeting, referred at the outset to the retirement from the office of Hon. Secretary of Mr. Atkins. " I think we ought to express our thanks to him for his untiring efforts," he said. " We must thank him for having organised this from the very beginning. One or two others of us were interested in a lukewarm sort of way, but Mr. Atkins kept us to it and there is no doubt whatever that but for him we should not be here to-day. (*Applause.*) At the same time I would like to welcome our new Secretary, Mr. Watson, who has been under Mr. Atkins's guidance for the

past two or three months—and I do not know now which I fear the most." He also expressed the Industry's thanks and appreciation for the often-maligned Commission Salesmen, " on whom we all rely."

Mr. Atkins presented his Annual Report, which ran: "A year ago, in order to consolidate our initial year's encouraging achievements and to plan ahead, we decided to increase the annual subscription from Three to Four Guineas. Despite this increase, Grower Membership now exceeds 200, with another 90 or so Honorary Members resident in this country and in the United States, France, Denmark, Switzerland and South Africa.

A logical development has been the appointment (six months earlier than we had hoped possible) of a whole-time Administrative Secretary to relieve me of my secretarial duties and release Mr. Middlebrook from his arduous editorial and advertising management of our magnificent Bulletin. Mr. Angus Watson joined us in July.

Progress during 1947 has been steady and solid. Research has taken the foreground of the picture. You will recall that at our First Annual Luncheon, at which Dr. Wilkins of the Ministry of Agriculture officially recognised the Mushroom as a food and the M.G.A. as the organization representing the growers of the mushroom, the suggestion was made that the M.G.A. and the Mushroom Research Association Ltd. pooled their resources. The M.G.A. approached the Research Association, which at once agreed (on the two conditions that the scale of the current programme should be maintained and that the Mushroom Industry should decide what problems were to be investigated) offered the Ministry of Agriculture the Station, Equipment and Staff free of all cost. Owing to the prolonged illness of Dr. Taylor this offer to the Ministry by Sir Oliver Leese and me was delayed until an unfortunate moment: it coincided with the arrival of the financial crisis, and the prospect of an annual charge of £4,000 for mushroom research was too much for a Department anxiously looking round for economies. So the Research Association had to revert to the status of a private company limited by guarantee.

To offset this major disappointment, we have received Ministerial assurance that mushroom problems will be investigated at the proposed national Glasshouse Research Station, and that we growers shall be asked to serve on a Committee to advise on the problems requiring investigation. We must agree on a programme and the order of priority of our many problems at the earliest possible moment. Mushroom houses are to be built in which laboratory results may be subjected to commercial test, and our friends in the N.A.A.S. will watch with close interest.

All will be pleased to learn that our Technical Library now possesses 100 different volumes and papers which are proving of increasing value to members.

The Tariff Duty on mushrooms has been revised by the Geneva Conference. For five summer months it is to be 10%, and for seven

winter months 20% *ad valorem*, to be calculated on the gross price on arrival in this country.

We have already seen indications of the problems which will face us in 1948. References in the Trade Press to the short supply of horse manure are becoming more frequent. Sir Stafford Cripps's warning that ' the rate of deterioration of railway wagons is out-stripping repair and replacement ' means that we can expect restrictions on the use of wagons this wnter even if we escape embargoes. New timber is almost unobtainable, and we are asked to experiment with alternatives for shelving.

In conclusion, thank you, members, for the interest and sympathy with which you have always received my efforts on behalf of the Mushroom Industry in general and the M.G.A. in particular ; it has been for me a delightful and instructive period in office during the formative years."

The Annual Report was adopted on the proposition of Mr. F. M. M. Beerling, seconded by Mr. J. Stewart-Wood.

Mr. Major presented his Financial Statement. " I think we can congratulate ourselves on having had a successful year, because we have been able to turn a loss on last year's accounts into a balance on the right side. It is not a large one, but it indicates movement in the right direction and shows that the Association has been established on a firm footing. That result has been achieved by rigid economy and by the fact that the Bulletin has become self-supporting, largely due to the splendid way in which the Honorary Members have consistently rallied with their advertisements. The Committee has several projects under consideration for publication and additional technical information, but these cost money and can only be put into effect if the M.G.A. continues to expand. I hope none of us will lose any opportunity that presents itself of gaining more members."

The Accounts and Balance Sheet were adopted on the proposition of Mr. R. Duthy, seconded by Mr. J. B. Morris.

OFFICERS FOR 1948

The following officers were elected for 1948 :—

Chairman : Mr. Stanley Middlebrook.
Vice-Chairman : Lt. Gen. Sir Oliver Leese, Bart.
Hon. Treasurer : Mr. Percy C. Major.

Vacancies on the Executive Committee were filled by Messrs. A. Deb. Hovell (Sussex), W. A. B. Harding (Kent), H. S. Allsop (Scotland), F. C. Atkins (Northants.) and J. Stewart-Wood (Bucks.) These members join Messrs. R. S. Fryer (Bucks.), C. L. Sinfield (Yorks.), R. Patterson (Northern Ireland), C. P. Chamberlain (Wilts.) and K. V. S. Francomb (Sussex).

Mr. H. Feldon Baker was re-appointed Auditor.

At the conclusion of the business an open discussion was held. A number of topics were brought up, and will be fully reported in the next issue of the Bulletin. Space precludes details this quarter, but a note of the discussion will be placed in the Association's Library – for those who cannot wait !

BALANCE SHEET as at 31st October, 1947.

1946	SUNDRY CREDITORS	£ s. d.	s. d.
£	Subscriptions paid in advance :—		
219	Ordinary Members	40 19 0	
24	Honorary Members	3 3 0	
			44 2 0
18	Luncheon Tickets bought in advance	38 10 0	
5	Audit Fee	8 8 0	
			46 18 0
	National Farmers' Union 1946/47 Subscriptions		83 12 8
	Excess of Income over expenditure 1946/47	113 13 11	
	Less Excess of Expenditure over Income brought forward	29 6 8	84 7 3
£266			£258 19 11

£ s. d.	£ s. d.	1946 £
Office Equipment as per last Balance Sheet....	114 9 10	
Additions	23 13 4	
	138 3 2	
Less Depreciation	13 3 2	
	125 0 0	115
Library at valuation	2 0 0	
Cash at Bank	100 3 10	
Cash in Hand	2 3 0	
Postage Stamps in Hand	3 1	
	102 9 11	122
Sundry Debtors	29 10 0	
Excess of Expenditure over Income	—	29
	£258 19 11	£266

INCOME AND EXPENDITURE ACCOUNT for the year ended 31st October, 1947.

£	£		£ s. d.	£ s. d.
294		To Bulletin & Publications	—	—
57		*Less* Advertising Space & Sales	—	—
— 237				—
	12	Subscriptions to Trade Journals		8 9 9
	50	Salaries & Clerical Assistance		258 2 5
	—	Honorarium—Mr. F. C. Atkins		200 0 0
	58	Postage, Printing & Stationery		113 14 10
	3	Miscellaneous Expenses		22 1 1
	2	Travelling Expenses		10 12 11
	1	Bank Charges		1 16 0
	5	Audit Fee		8 8 0
	–	Cost of Luncheon 1946	86 17 0	
	–	*Less* Sale of Tickets	44 11 0	
				42 6 0
	13	Depreciation of Office Equipment		13 3 2
	—	Excess of Income over Expenditure		113 13 11
	19	Advertising		—
£402				£792 8 1

£ s. d.	£ s. d.	£	£
By Subscriptions from Ordinary Members in respect of 1946/47	794 17 0		351
Less Amount due to National Farmers' Union 1946/47	83 12 8		48
	711 4 4		— 303
Subscriptions from Honorary Members 1946/47	66 3 0		30
Subscriptions—Honorary Associates 1946/47	5 5 0		—
Sale of Advertising Space in and Sale of Bulletin	389 1 7		
Less cost of Bulletin & Publications ...	379 5 10		
	9 15 9		
Excess of Expenditure over Income	—		69
	£792 8 1		£402

We have compared the above accounts with the books and vouchers and certify the same to be correct and in accordance therewith.

NORTHAMPTON, *25th November*, 1947. (Signed) BAKER & CO., *Auditors*

Dr. W. F. BEWLEY, C.B.E., D.Sc., V.M.H.
Director of Research at Cheshunt
writes in detail on Experiments conducted at Cheshunt on

MUSHROOM CASING SOIL

The cultivation experiments with mushrooms started in 1936, when a mushroom shed fitted with shelves was erected. Half the cost was provided by the Ministry of Agriculture while the late Mr. J. Harnett presented the heating system and Mr. Ben Rubenstein the Western Red Cedar of which the shelves and their supports were constructed.

The first experiment started on 6th April, when prepared compost was taken into the shed. The investigations were discontinued in 1939 at the outbreak of war and were not resumed until the end of 1946.

At the commencement of this work, the investigations were concerned entirely with the question of " casing " soil. In 1936, second spit soil was obtained from Mr. J. Harnett's nursery at Hoddesdon, Mr. C. J. Horwood's nursery on Cheshunt Common, and from two nurseries in the West Sussex area. All were heavy soils, the first two being brick earth and the second two heavy silts. All were practically free from organic matter. Mushrooms were picked first from the beds cased with soil from Cheshunt Common and six days later from the other three sections simultaneously. Sixteen days after picking commenced there was an outbreak of *Mycogone* in six plots, all cased with the same soil. This was checked early by removing the infected clumps with a handful of compost, dusting the hole liberally with hydrated lime and then filling up with new soil containing 33 per cent. of lime. Later an outbreak of " truffle," *Pseudobalsamia microspora*, started on beds cased with another soil and this spread to adjoining plots so rapidly that it affected the weight of crop and rendered any attempt at comparison between the different treatments quite useless. Incidentally, this was the first record of this disease in England.

These first experiments were most valuable, however, for they showed that mushroom diseases can be carried in casing soil and proved the wisdom of sterilising any soil used for casing.

In 1937 the problem of the casing soil was examined further. The soils used were as follows :—

(*a*) Research Station soil—a light loam moderately rich in organic matter.
(*b*) Nazeing Common soil—a light loam almost free from organic matter.
(*c*) Cheshunt Common soil—a heavy soil, rich in organic matter.
(*d*) Hoddesdon soil –a brick earth, heavy and free from organic matter.

All soils were sterilised by steaming at a temperature of 212° F., steam being passed into the soil for 30 minutes. The total yield was unusually high, probably because very good stallion manure was used for the beds and the spawn, Exhibition White made by the late Mr. J. Harnett, was exceptionally good. The Hoddesdon casing soil gave the

highest average yield of 3·86 lbs. per square foot. The Research Station soil gave 3·45 and Cheshunt Common soil 3·42 lbs. per square foot, while Nazeing Common soil produced 3·16 lbs. per square foot.

There was little difference in the average weight of the mushrooms produced, but those on the Research Station and Cheshunt Common soils had longer stalks than those in the other two soils.

During 1937 small-scale experiments were arranged in which the beds were cased with the following : granite chips ; stones ; sand ; peat ; equal parts Research Station soil and stones ; equal parts soil and sand ; equal parts soil and peat ; two parts soil and one part charcoal. Sand (1·48 lbs. per square foot), stones (1·8), peat (0·81), and granite chips (1·49) all gave a low yield, although the granite chips and stones produced very heavy mushrooms. Sand, stones, and peat respectively mixed with equal quantities of peat, all produced good mushrooms. The crop at the end of the first 10 days was 1·30 lbs. per square foot (peat and soil), 1·27 lbs. (stones and soil), and 0·65 lbs. (sand and soil). At the end of March these plots were recased, however, and the result was unsatisfactory. The habit of growth of the mushrooms in the above experiments was most unusual for the whole surface was covered with a solid mass of small, long-stalked mushrooms. The result, therefore, is of little interest commercially. It is valuable, however, because it shows that the growth of mushrooms is affected to a marked degree by the type of material used for casing the beds. The earliness of cropping and the increase in crop weight suggests the need for further investigation along these lines.

In a further experiment it was shown that white flake naphthalene and also sodium fluoride can be mixed with the manure immediately before making the beds without affecting the yield. The rate of application in each case was 3 lbs. per ton of manure.

In 1938 the casing soil experiments were continued, using various mixtures of soil, peat and stones. Once again the addition of peat increased the yield appreciably, the average yield from the control beds, cased with soil only, being 1·55 lbs. per square foot and those cased with a mixture of two parts soil and one part peat produced 1·8 lbs. per square foot. Where stones were added to the extent of 33 per cent. the increase was slight and where the mixture contained both stones and peat the yield was unaffected.

The effect of mixing gypsum—28 lbs. per ton of manure at the first turning -was examined and in each case the crop yield fell when gypsum was omitted. The average yield was 1·02 lbs. per square foot where gypsum was omitted and 1·54 lbs. per square foot where it was added.

Reduction in crop has been traced occasionally to a type of secondary fermentation of the beds which gives rise to a sweet smell, resembling that of molasses, about five weeks after spawning. This suggests imperfect fermentation during the preparation of the compost, and an attempt was made to correct this by mixing cotton seed meal at the rate of 28 lbs. per ton of manure at the first turning. The results of these experiments were promising, the crop yields being increased from 1·5 lbs. per square foot in the control beds to 2·15 lbs. by the addition of cotton seed meal.

The question of temperature was also investigated. Air temperatures of 55°, 60°, and 65° F. were employed, and in an unheated chamber the bed temperature was maintained at 70° F. by means of electrically-heated cables placed in the soil beneath. The results are given in the following table :—

Temperature of Air	Colour of Strain	Weight in Lbs. per Square Foot					
		Jan.	Feb.	March	April	Total	Average Total
65° F.	Brown	0·26	1·12	0·37	—	1·75	1·87
		0·32	1·19	0·37	0·10	1·98	
	White	0·03	0·96	0·22	0·01	1·31	1·39
		0·17	0·93	0·33	0·03	1·46	
60° F.	Brown	0·28	0·90	0·25	0·01	1·52	1·81
		0·35	1·23	0·43	0·09	2·10	
	White	0·23	0·70	0·23	0·02	1·18	1·45
		0·13	1·13	0·42	0·03	1·71	
55° F.	Brown	—	0·58	0·47	0·35	1·40	
	White	—	0·23	0·23	0·33	0·79	
Air not heated. Bed kept at 70° F. electrically.	Brown	0·16	0·82	0·37	0·09	1·44	
	White	0·22	0·38	0·12	0·01	0·73	

It will be seen that there was a reduction of crop at the lowest temperature 55° F. and little difference between 60° and 65° F. Incidently, the average size of the mushrooms was not affected by the different temperatures. The importance of the air temperature is seen in results at the bottom of the table, where, although the beds were maintained at a temperature of 70° F. there was a falling-off in yield due to the unheated atmosphere above the beds.

In a further experiment one bed 4 ins. deep was placed over electrically-heated cables in narrow troughs containing water, with the object of warming the beds and preventing them from drying out at the same time. The bed temperature was maintained at 75° F. constantly. As a control, a bed 4 ins. deep was placed over a layer of moist soil of the same depth. The results are given below: —

Treatment	Crop Yield in Lbs. per Square Foot					Average Total
	April	May	June	July	Total	
Control —4-in. Bed	1·20	0·80	0·24	0·10	2·34	1·61
	0·40	0·36	0·08	0·04	0·88	
Bed—4-in.—Warmed	1·52	0·56	0·04	—	2·12	2·20
	1·52	0·68	0·08	—	2·28	

These results are not convincing, but they show greater uniformity between the two warmed beds than between the controls. Further, the reduction of the depth of the composted manure from the standard 8 ins. to half this depth does not seem to have affected the yield appreciably.

Summarising the results of these experiments, several important points emerge.

(1) Mushroom diseases can be introduced in soil used for casing the beds, and for this reason it is advisable to sterilise all casing soil by means of heat.
(2) Thorough cleaning and sterilisation of the house, shelves, etc., between crops is an essential part of disease and pest control.
(3) Heavy clay or silt soils free from plant roots are the most suitable for casing purposes.
(4) In some cases the crop can be increased by mixing an appropriate amount of moist peat with the casing soil before application. 20 to 30 per cent. of peat is recommended for trial purposes.
(5) The addition of gypsum to the manure at the first turning almost invariably increases the yield.
(6) The addition of cotton seed meal—28 lbs. per ton of manure—at the first turning has increased the yield of mushrooms.
(7) Air temperatures of 60—65° F. are probably the optimum for mushroom cultivation.

(*Reproduced from the* 1946 *Annual Report of the Experimental and Research Station, Turner's Hill, Cheshunt, Herts., with the permission of the Director of Research—which is acknowledged with gratitude*).

U.S. Co-operation

I was very glad to receive your Library List, and I am enclosing a few of my reprints that you do not appear to have listed. Most of them are old and will probably be of historic interest only. I shall try to keep you in mind and if I have a chance to pick up reprints of papers published in this country that would be of interest to you, I shall be glad to do so. (Dr. E. B. Lambert.)

Scale Wanted

In the article on Mushroom Growing in Trays a plan is given of a layout to produce 100,000 lb. annum, but there is no mention of the scale of the plan. This is a most stimulating article, as is the one on Soils. (John Atkins.)

(*The Editor apologises: The scale of the plan on page* 161 *of Bulletin* 9 *is* 1 *inch to* 100 *feet.*)

Curious Chart

A recent issue of *The Smallholder* carried a curious chart of Mushroom Diseases. Verticillium Wilt, it said, occurred in beds where horses had been physicked. Pip Disease (Dying Pin-heads) was caused by cold draughts, ice cold water, yet could be overcome by watering with permanganate of potash solution.

Plaster Mould could be prevented by mixing gypsum with the compost at the first turn, and Gill Mildew said to be caused by violent temperature changes, could be controlled by dusting with green sulphur. It all rather staggered me, as a student of Mushroom Diseases.

(Fred. C. Atkins.)

ARE YOU IN TROUBLE?

ADVICE FOR SCOTTISH GROWERS

The N.A.A.S. covers England and Wales. The corresponding advisory service in Scotland is based on the three Scottish Agricultural Colleges located as follows :

1. **The Edinburgh and East of Scotland College of Agriculture,** 13 George Square, Edinburgh.
2. **The West of Scotland Agricultural College,** 6 Blytheswood Square, Glasgow, C.2.
3. **North of Scotland College of Agriculture,** 41½ Union Street, Aberdeen.

The respective College Areas are :—

East	West	North
Berwickshire	Argyllshire	Aberdeenshire
Clackmannanshire	Ayrshire	Banffshire
Fife	Bute	Caithness
Angus	Dunbartonshire	Inverness-shire
East Lothian	Dumfrieshire	Nairn
Kinross	Kirkcudbright	Morayshire
Midlothian	Lanarkshire	Orkney
West Lothian	West Perthshire	Ross and Cromarty
Peebleshire	Renfrewshire	Shetland
East Perthshire	Stirlingshire	Sutherland
Roxburgh	Wigtownshire	Kincardineshire
Selkirk		

Enquiries in each case should be addressed to the Director of County Work.

ADVICE FOR GROWERS IN NORTHERN IRELAND

All enquiries should be addressed to the Agricultural Executive Officer for the County in which the enquirer resides. The names and addresses of these officers are as follows : —

Co. Down. J. T. KERNOHAN, Esq., Murphy's Buildings, 69 May Street, Belfast.

Co. Antrim. T. ROBINSON, Esq., 40 Ballymoney Street, Ballymena, Co. Antrim.

Co. Tyrone. W. J. PATTERSON, Esq., Dublin Road, Omagh, Co. Tyrone.

Co. Armagh. J. ALGIE, Esq., 16 Russell Street, Armagh.

Co. Fermanagh. W. T. MCCLINTOCK, Esq., Tully's Buildings, Enniskillen, Co. Fermanagh.

Co. Londonderry. T. K. CALDWELL, Esq., Courthouse, Coleraine, Co. Londonderry.

Ministry of Agriculture. The address of the Entomology and Plant Pathology Divisions of this Ministry is :

Agricultural Buildings,
Elmwood Avenue,
Belfast.

MRS. H. F. G. ROBERTSON

SOUTH AFRICAN MUSHROOM FARM

By

MRS. H. F. G. ROBERTSON
of Johannesburg
Honorary Member of the M.G.A.

Cultivated mushrooms have appeared on the South African market only spasmodically — when some grower has had a lucky crop. Regular, all-the-year-round production on a commercial scale has so far been unknown to the public here. The reason for this is that both our raw materials and our climatic conditions present problems to the grower to which he can find no answer in British or American literature. He must be prepared to spend money on original research to overcome the difficulties with which he is faced.

To begin with, the difference between our day and night temperature is very considerable and no matter how well a house is insulated—above the ground—temperature control is virtually impossible. It was found that even under ideal conditions mushroom houses above the ground produced poorly, while mushroom beds planted in well-insulated cellars produced heavily—even under slightly adverse conditions.

Wheat straw is expensive in the Johannesburg area (the largest market being situated here) and stable owners bed their horses on shavings. Stables are cleaned daily with the result that the material contains virtually no urine. Market gardeners offer high prices for this poor material, and there is a keen competition for all available manure. The mushroom grower must either own the stables himself or make his arrangements through friends and personal contacts.

It is extremely difficult to find a suitable soil for casing in South Africa. The general texture of our soil is sandy with a very low humus content and virtually no water-holding capacity. The only suitable soil is found in low-lying places where the water of past centuries has collected silt which is rich in humus and has the right texture. Such soil, however, contains fungus diseases in abundance and has to be sterilized. Soil generally has to be carted for long distances.

It will be seen from the foregoing that the mushroom grower must be prepared to outlay considerable capital—for the construction of his sheds underground, for transport facilities, and for the acquisition of suitable raw materials.

The walls of underground sheds are constructed " Pise-de-terre " style—the aggregate used being cinder, gravel and cement. Steel or wooden shuttering is used and the ramming is done by native labour. The result is a stout wall, some eighteen inches thick, which will resist seepage during heavy rains from without, and the continual play of the water hose from within. The walls rise out of the earth for a foot at the sides and two feet in the centre—a curved concrete slab being used for roofing. This arrangement allows for small windows at either end—these are useful for admitting light and they assist in summer cooling when a breeze is allowed to filter through ventilators and air bricks and out through the windows. The rooms are kept very wet in hot weather. The temperature control is further accomplished by means of about 8 ins. of grass and 6 ins. of soil over the concrete slab for insulation. Sheds constructed on this principle will maintain suitable growing temperatures all the year round.

However, for the sweat-out and spawn-running, it has been found advisable to construct separate rooms—similarly constructed and insulated—but equipped with a boiler. The compost is conveyed into these chambers in boxes and the pasteurizing and conditioning is accomplished under ideal conditions. Spawn can also be run at 75° F. all the year round—regardless of bitter winter winds.

The " Two-zone " or tray system of culture has been found to be particularly useful under South African climatic conditions, and the day is not far distant when South Africa will have a very substantial mushroom industry, as it has been found possible to overcome almost every major difficulty by means of the methods outlined herein.

The system outlined has, however, been evolved especially for the high-veld; in humid, sub-tropical areas, like the Province of Natal, other means of cooling would have to be found and heating would be totally unnecessary. It is doubtful whether it would be possible to maintain suitable growing temperatures all-the-year-round in Rhodesia for instance—a province where a very excellent market exists and where there are virtually no mushroom growers operating on a large scale.

In the Cape Province, it may be possible to get good results above the ground. The climate in this province is less changeable and in coastal areas the humidity is much more like that of England. The winter rainfall produces a milder cold—not like the sharp, dry, icy winds of the high veld of the Transvaal.

As long distances have to be traversed both for raw materials and for taking mushrooms to various hotels, markets and other places of distribution, it is essential for the commercial grower to have at least two trucks—one three-ton for heavy cartage and one lighter truck for delivery of crops.

As mushrooms have appeared only recently on the South African market they are regarded with suspicion. There are reports every year of a number of deaths from mushroom poisoning—generally wild mushrooms gathered by natives and Indians, and it is extremely difficult to make the public appreciate the cultivated product. As the public in general is ignorant of the very elaborate methods required to cultivate mushrooms successfully, they are not willing to pay higher prices for the far superior, cultivated product. So the commercial grower of to-morrow will not only have to conquer the difficult conditions here, but he will also have to educate the public to pay for his product.

EUROPE, THE U.S.A. AND US

A comprehensive comparison between different methods of growing mushrooms, specially written for this Bulletin

By LT. COL. E. NOEL

The technique of growing most crops does not vary fundamentally from country to country. Mushrooms are an exception. On the Continent they are grown underground, in England in surface buildings, in America both methods are employed. The production in these three countries in 1939 was as follows :—

France	40 million pounds
(*of which* 60% *were preserved and* 40% *eaten fresh*)	
America	35 million pounds
Great Britain	13 million pounds

It has been said that the criterion of a good engineer is his ability to produce a standard article economically. The same criterion is applicable to the mushroom grower. To compare Continental with English methods we must therefore see which produces mushrooms of equal quality at the lowest price. To make a true comparison we are up against the difficulty of exchange. Are we to take the official or the black-market rates? The latter are changing. In Belgium the official rate is 177 francs to the pound. Less than a year ago the pound was worth 200, now it is 145 and still falling. It will be advisable to rely on the official rate. On this basis the price of mushrooms in France and Belgium (winter of 1947) is half that in England, after allowing for the fact that in England mushrooms are sold with much of the stalk removed. It may be objected that this comparison is valueless without considering other costs, the most important of which are manure and labour. Taking again official rates of exchange it will be found that these costs are roughly the same on both sides of the Channel. As French and Belgian growers are quite satisfied with the prices they are getting, it would seem that the British grower is on a very good proposition, or his methods are more costly. In view of the great advantages of underground cultivation the latter cause is the more likely one. What are these advantages?

Mushrooms grow best in a humid atmosphere (70 to 80 per cent. relative humidity) at temperatures between 50 and 55 degrees Fahrenheit. These conditions are obtainable underground. In surface houses they have to be maintained artificially by heating in winter, and cooling in summer. In underground cultivation sand in its natural state can be used as casing. Above ground a carefully selected soil must be used which should be sterilized; the cost is considerable.

Underground accommodation is generally available at a very cheap rate. On the Continent it works out at about one farthing per sq. ft. of bed cultivated. Properly equipped mushroom houses are expensive and the maintenance and depreciation charges are considerable, whereas underground they do not exist. In France and Belgium the lorry is driven into the cave and unloads its manure where wanted; on the surface the manipulation of the manure must be more expensive.

Composting can be carried out underground. This holds advantages over hangars or sheds. The capital cost is less, the conditions for composting are better, the time taken is shorter. It was mentioned that the optimum growing temperature is 50 to 55 degrees. For the spawning period (the first three weeks) a higher temperature (70 degrees) is preferable. In caves with a low roof (10 ft. and less), this temperature can be attained by the fermentation of the manure.

It may be asked why in the face of these prominent advantages English growers won't use caves. The reason seems to be the increased risk of pest and disease owing to :—

1. Difficulties in ventilation and disinfection.
2. Effective sweating and pasteurizing of manure is not possible.
3. Dripping of water from the roof and excessive humidity in summer.
4. Distance from markets and manure frequently great.

There is such a strong prejudice in this country against underground growing that only one concern is doing so on a big scale. It is working near Bradford-on-Avon, in Wiltshire. In " The Cultivation of Mushrooms," by Bewley and Harnett, there is mention of a Company using a tunnel at Edinburgh, in 1886, and turning out 5 tons of mushrooms a week. This Company has long since disappeared. It has not been possible to ascertain the causes of its failure. Doubtless they were due to those already mentioned, which also accounted for failures and much loss of money from early attempts to grow mushrooms in the caves at Godstone in Surrey and Chiselhurst in Kent.

Nevertheless, Continental growers have learnt how to overcome these difficulties, partly by selecting the right type of cave and partly by applying a suitable technique.

The selection of the cave is most important. *The ideal is an abandoned stone quarry into which a lorry can be driven. The natural detritus from the stone will act as casing. There will be no general drip of water. Relative humidities will be fairly constant through the year and not exceed* 80%. *Temperatures will be between* 50 *and* 55 *degrees. It will be near markets and manure.*

Stone quarries are compact in shape and this facilitates division into separate growing sections for which vertical ventilating shafts are provided so that each section can exhaust its used air up a ventilating shaft without passing over another section where mushrooms are growing. An adequate provision of ventilating is essential. In France there is one to every 20,000 sq. ft. It is necessary to change the air twice in every 24 hours. For 20,000 sq. ft. of beds 1 to 2 h.p. is sufficient to operate the ventilating fan. The air is sucked in by the tunnel of access and escapes through the ventilating shaft. The motor is only needed in summer ; in winter the warmer air of the cave produces a natural draught.

The movement of air should not be too violent. To prevent too strong currents growers employ moveable screens of boarding or corrugated iron sheets. Nicotine and D.D.T. are used too for the control of flies and other pests. This is especially necessary for composting the manure underground which should be done conveniently close to a ventilating shaft.

The surface of the caves is disinfected with quicklime, calcium hypochloride and other disinfectants. A most important precautionary measure is the sprinkling of the floor with quicklime and on top of it a layer of sand, before making the ridges. When the latter have finished bearing, these two underlying layers are meticulously scraped up and removed. In some localities the farmers, in return for the spent manure, remove it and then complete the scraping.

By far the most important precaution is that no part of the cave should bear mushrooms more than once in two years. This rest is very essential. Experience shows that higher yields are obtained when a cave is first brought into use. A longer rotation than two years would of course be better. Many English growers are up against soil contamination due to growing mushrooms too long in the same house. It generally appears before seven years have elapsed. As caves are obtainable with ample floor space, there should be less danger of contamination than in mushroom houses.

The most important objection to underground cultivation is that effective pasteurization and sweating of the manure is not possible. This has been overcome in America, as Dr. Sinden has described for us, by the introduction of the two-zone or tray system. It is also being taken up in Switzerland. One of the English research stations, to whom the idea was submitted before it was known that it was in vogue in America, preferred not to advise regarding the prospect of success or failure, as it seemed to them such a complete departure from the standard process. French growers were immediately attracted to the idea but expressed misgivings on the score of increased operational costs. American experience shows that the two zone system in caves is the best and most economical method of growing mushrooms (see Farmers Bulletin No. 1875, pages 9 and 36).

But even with the old tradional methods mushroom growers in France and Belgium have learnt how to safeguard crops of mushrooms in caves from pests and disease. In the many farms visited very little disease was observed.

In the light of the above it will be understood that the tunnel at Edinburgh was probably unsuitable as it did not provide for proper ventilation. In a railway tunnel the thickness of the overburden would generally be too great for ventilating shafts. Adequate ventilating shafts are a *sine qua non* for underground cultivation.

Comparisons of the following further points are worth attention :

SPAWN

In England the varieties of spawn sold are very limited. In France and Belgium they are many. It is believed that the spawn must suit the cave's condition and the manure. Mushroom growers have special expressions for the atmosphere of a cave. The terms used are " ambiance " and " sueve." The grower on describing the general conditions of his cave will receive from the manufacturer a number of spawns for trial. The final selection depends on the grower's talent for trial and observation.

Spawn has not risen in price in the same way that mushrooms, manure and labour have done. Growers therefore use more than they used to.

In France 5½ lb. of spawn are used for one ton of manure; in Great Britain less than half this quantity is used.

MANURE

There are many complaints on the Continent of the bad quality of present-day manure, owing to the poorness of horse food. Many horses are now fed on molasses, which gives a particularly unsatisfactory manure. Many growers have contracts with local horse owners. The rate is about 25 shillings a month which should give on an average 12 cwts. of manure. The grower has to collect and for this purpose maintains his own lorry. From 3 to 5 kilos. of ammonium sulphate are added to each ton of manure. The addition of gypsum is not common.

UNIT OF CALCULATION

In England the yield is expressed per sq. ft. of bed, whereas in France and Belgium it is per ton of manure. The latter undoubtedly gives the better picture, as the most important component in the cost of growing mushrooms is the price of manure. The next important component is the cost of labour, but this in its turn depends greatly on the weight of manure handled. The ratio of area of bed to weight of manure varies from 40 to 70 sq. ft. per ton. With manure of a density of 35 lb. per cubic ft. and flat beds 6 inches deep, one ton of composted manure will make 127 sq. ft. of bed. A typical Continental ridge would provide 140 sq. ft. of bearing surface per ton of manure (weight after composting).

YIELDS

In England a pound a sq. ft. is considered average (cf. p.34, Bulletin 34, " Mushroom Growing " : Ministry of Agriculture). In the U.S.A. the average is put at 1½ lb. (cf. p. 36, Bulletin No. 1875 : U.S.A. Dept. of Agriculture). In France and Belgium, with 60 sq. ft. per ton of manure the yield is 1·44 lb. per sq. ft. (average yield is 40 kilos. per ton of original manure).

RATIO OF BED SURFACE TO WEIGHT OF MANURE

With flat beds 6 inches thick there will be 65 sq. ft. per ton of manure. The majority of ridges in France and Belgium run 11 metres to the ton, equivalent to 70 sq. ft.

In America the tendency is to use less manure and many growers are now getting from 80 to 100 sq. ft. per ton.

One English grower is successfully using beds only 4 inches thick equivalent to nearly 100 sq. ft. per ton.

A Belgian grower was spawning compressed blocks of compost which he eventually turned over, casing the bottom and getting another ¾ lb. per sq. ft.

The Americans claim that by the indoor method of composting recently explained to us by Mr. Harding, one ton of manure suffices for 200 sq. ft. of bed.

LABOUR

As already mentioned, wages on the Continent are not much different from those in England. As, however, the system of piece work is in vogue, costs tend to be lower than when daily wages are paid. The contract rate for making two metres of ridge (including spawning and casing), is 18 francs or 9d. Two metres of ridge is equivalent to about 12 sq. ft. of flat bed.

A French mushroom hand deals with about 120 tons of manure per annum, yielding 10,000 lb. of mushrooms. (This includes picking and packing.)

The following shows the French grades with current prices :

Grade	Percentage of Crop	Wholesale price per lb.
First	60 per cent.	2/9d.
Second	20 per cent.	2/4d.
Third	20 per cent.	2/-d.

The retail prices in France are controlled at 15% above wholesale.

COSTS

Manure	£3 5s. 0d. per ton delivered at site.
Spawn	13s. per ton of manure.
Labour at 14s. per day	£1 14s. 0d. per ton of manure.

Beach as a Casing element

A man, connected by trade with the mushroom growing industry, once told me that in the course of his travels he had accidentally come upon a grower of mushrooms who grew with success his mushrooms in beach as a casing element.

I say " accidentally " because it was alleged that this grower had " found something " and was " keeping it to himself ! " My informant went on to describe the verbal trouble that he got himself into for accidentally trespassing and observing something he was not intended to see.

Of course, the mushroom industry has its fables and legends in the same way as may be found in other walks of life. None the less, my interest was roused sufficiently to case five square feet of indoor flat bed with builders' washed, pea-grade beach, and mushrooms grew in sufficient quantity and quality to justify further investigation.

On the following crop I cased 400 square feet with the same grade and quality of beach. However, I did not proceed with the experiment after the first few weeks of cropping, and I stripped it off and replaced with soil.

Here are my observations for what they are worth. The mushrooms grew too slowly to interest me as a commercial proposition, and I could find no husbandry to speed up their rate of growth. As individual mushrooms, however, they were of a better quality than any others I have grown. They grew singly and not in clumps and each mushroom was heavier than its counterpart in soil, and moreover was perfectly shaped. Whites took longer to grow than Browns.

" Coring " was a simple operation. After the mushrooms were cut, the cores could be lifted out and given a shake. The beach fell away from the core, leaving no hole to be filled up with fresh beach. The core thus removed was whole and quite clean, except for a very few pebbles in the midst of it. (Incidentally, the whole unbroken mushroom core with no earth to congeal and conceal it was, to me, an interesting sight.)

Another grower visited me and appeared lost in astonishment at my original five square feet of Browns in beach which were showing a nearly matured flush when he arrived. I understand he went away and did likewise with Whites on a larger area, finding much the same answer as I did on my bigger area of Whites and Browns, i.e., that exceptionally heavy and perfect mushrooms grew, but took too long in their coming !

Can anyone take this a stage further ? (Capt. M. E. Few.)

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